Urban Mapping using Satellite Time Series

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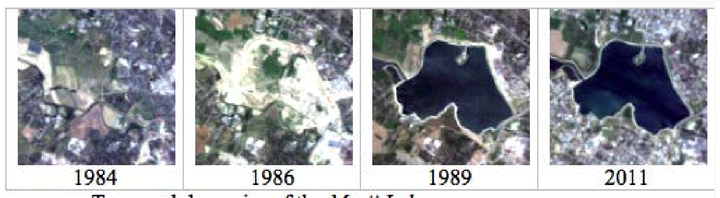
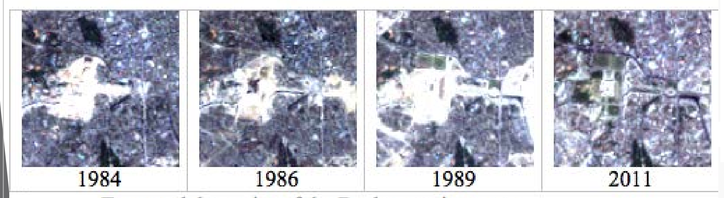
Abstract

When we analyze the development of urban areas, it becomes clear that satellite image time series are highly valuable data sources that can be exploited to describe - besides vegetation cycles and land use changes - the dynamics of urban settlements and their infrastructure.
Modern high resolution optical and SAR sensors with good signal-to-noise characteristics open new perspectives for local image classification and quantitative change analysis, while low resolution sensor data are often available over many years and provide more insight into long-term processes. Advanced analysis algorithms allow the identification of typical pixel changes and their confidence levels. Finally, data fusion represents a new perspective for urban mapping.

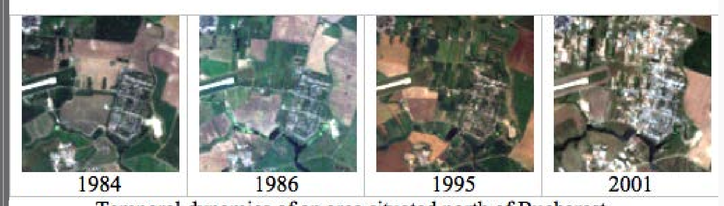
❖ Multitemporal satellite image time series: Analysis of urban development in and around Bucharest, Romania using Landsat data



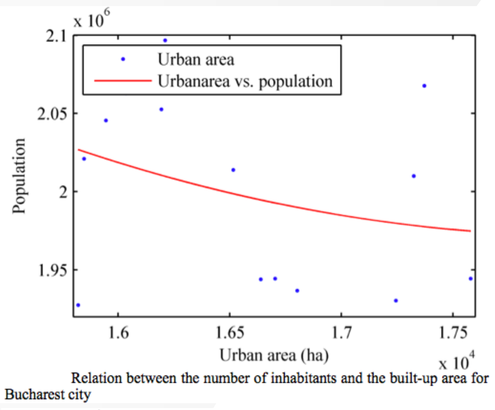
Temporal dynamics of the *Morii Lake*



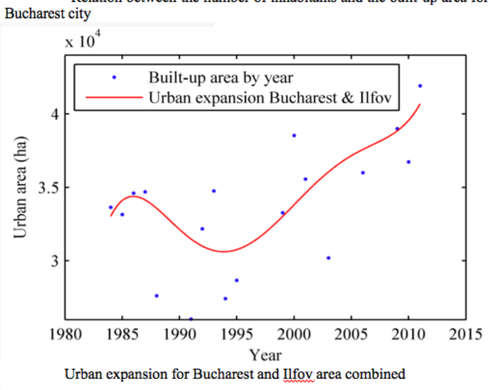
Temporal dynamics of the Bucharest city centre



Temporal dynamics of an area situated north of Bucharest

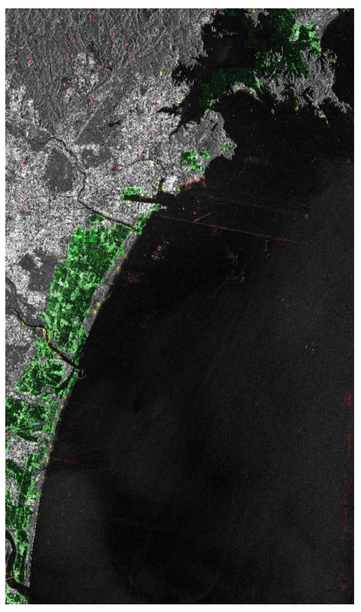


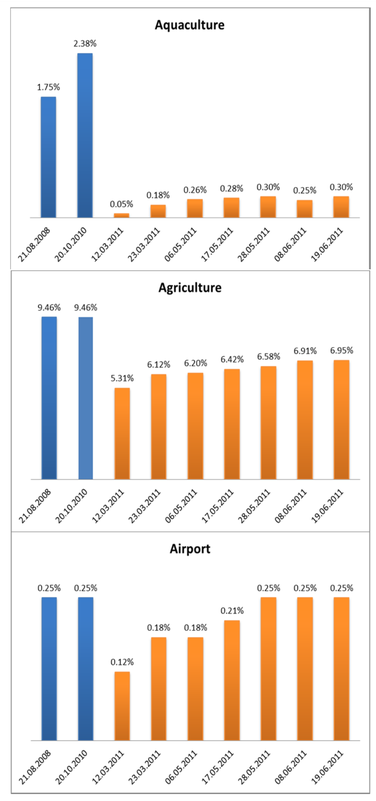
Relation between the number of inhabitants and the built-up area for Bucharest city

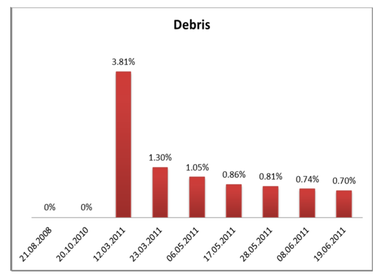


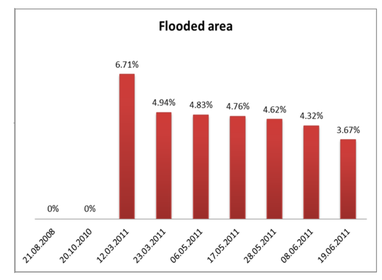
Urban expansion for Bucharest and Ilfov area combined

❖ Data analytics for rapid mapping: Effects of the 2011 tsunami in Japan using very high resolution TerraSAR-X data

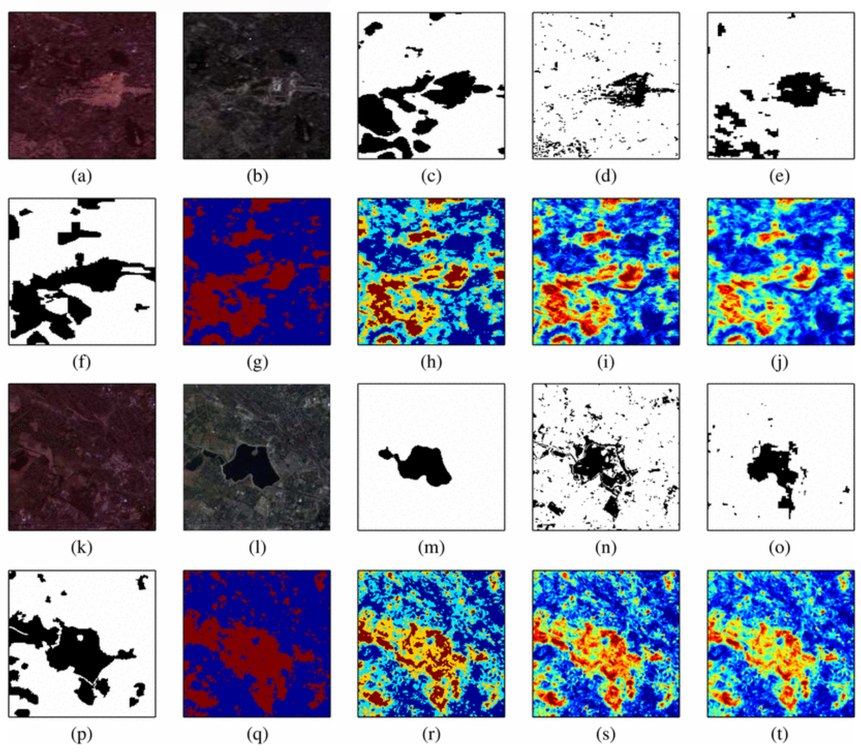




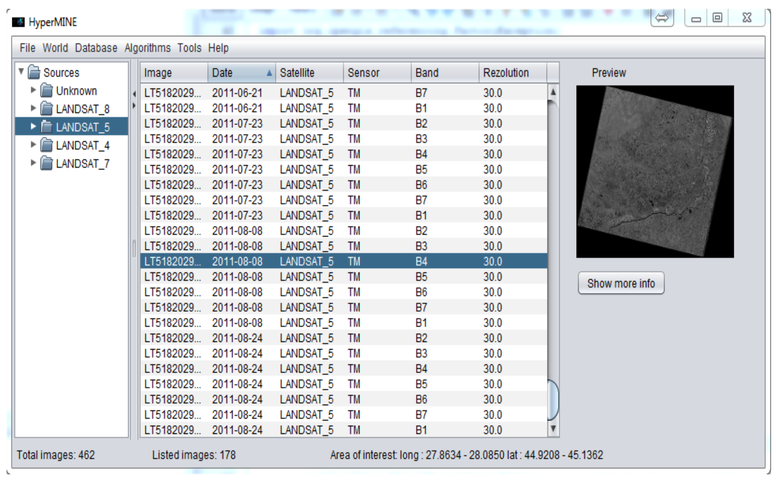


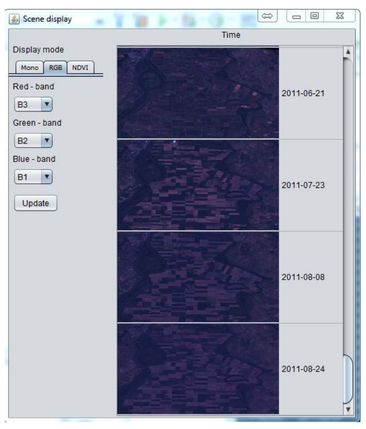


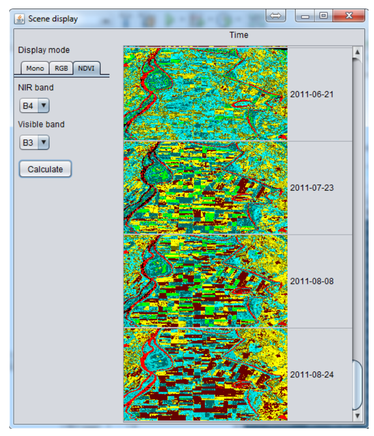
❖ Automatic change analysis in satellite images: Binary descriptors and Lloyd-Max quantization



❖ An Earth Observation spatio-temporal data mining system







Test Data Set

- Our test data set consists of:
  - 109 cloud-free images of Landsat TM and ETM+ with a spatial resolution of 30 m covering the areas of Bucharest and Ilfov in Romania.
  - 9 TerraSAR-X images with a resolution of 5.75 m. Two images were acquired as pre-disaster data (on September 21, 2008 and October 20, 2010) and 7 images were acquired after the 2011 Tohoku earthquake and tsunami, over Sendai, Japan as post-disaster data (for a period of three months from March 12, 2011 until June 19, 2011).
  - Landsat 7 images with a spatial resolution of 30 m for the period between 1984 to 1992, covering an area of approximately 59×51 km² over the surroundings of Bucharest, Romania. The main interest was the construction monitoring of the Palace of Parliament and the Morii lake.
  - 120 images acquired during the Landsat 4, 5, 7, and 8 satellite missions. These images cover the southern part of Romania and are centered around Bucharest.

References

[1] T. Costachioiu, R. Constantinescu, and M. Datcu, *"Multitemporal Satellite Image Time Series analysis of urban development in Bucharest and Ilfov areas"*, in Proc. 10th International Conference on Communications (COMM), Bucharest, Romania, 2014.
[2] F. Petitjean, A. Puissant, and P. Gançarski, *"Monitoring urban sprawl from Satellite Image Time Series"*, in Proc. IGARSS, Munich, Germany, 2012.
[3] C.O. Dumitru, S. Cui, D. Faur, and M. Datcu, *"Data Analytics for Rapid Mapping: Case Study of a Flooding Event in Germany and the Tsunami in Japan Using Very High Resolution SAR Images"*, JSTARS , Vol. 8 (1), 2015, pp. 114-129.
[4] A. Radoi and M. Datcu, *"Automatic change analysis in satellite images using binary descriptors and Lloyd-Max quantization"*, Geoscience and Remote Sensing Letters, Vol. 12(6), 2015, pp. 1223-1227.

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